The Use and Abuse of OEE

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Overall Equipment Effectiveness (OEE) is fast becoming a widely used measure for manufacturing industry, but it is also one of the more misunderstood and misused measures and causing much confusion.

What is OEE for?

The simple answer is "Improvement". OEE is an improvement measure and is used as part of the improvement cycle. Unfortunately, much is made of the 85% 'World Class Standard' an arbitrary target found in the original TPM literature. Not only is this target out of date (Nissan in Sunderland are running welding lines at 92-93% OEE) it gives the wrong message. A customer has no interest in your OEE – that is an internal measure, which relates to your efficiency and costs. The customer is far more interested in a measure such as On Time In Full (OTIF) ie did I get my order? Running a manufacturing business on an arbitrary efficiency measure rather than a customer satisfaction measure is a recipe for disaster. The best use of an OEE target such as 85% is to recognise that if you are reaching that level and the customer is still not getting his orders on time, then you may have a capacity constraint.

OEE does not tell us if we have a problem, the customer does. What OEE does do is help us analyse the problem and make improvements. This is why Toyota use it as a spot measure on a particular machine where there is a capacity or quality problem. Calculating the OEE of anything other than a discrete machine or automated line is pointless; we have far better measures of the efficiency of a factory or department as a whole.

OEE developed out of the need for improvement groups to have a way of measuring and analysing equipment problems as part of their Define, Measure, Analyse, Improve, Control cycle. OEE defines the expected performance of a machine, measures it and provides a loss structure for analysis, which leads to improvement. It can then be used as a tracking measure to see if improvement is being sustained ie if control is sufficient.

What does OEE measure?

At its simplest, OEE measures the Availability, Performance and Output Quality of a machine.

A machine is available if it is ready to produce, as opposed to being broken down or having some changes or adjustments made. The definition of availability allows for planned maintenance, when the machine is not meant to be available to production, but makes no allowance for changeovers etc. No machine with changeovers can ever be 100% available. The reason for taking such a hard line is that changeovers are a major loss to both efficiency and flexibility, so the OEE analysis focuses attention on it by making no changeover allowances.

Performance efficiency measures the output during available time compared to a standard. Here there can be debate about what the standard output should be. A good rule of thumb is to make the performance calculation based on best known performance. This may be greater or less than design speed. My argument is that if a machine has never reached its design performance it is not helpful to measure against that. On the other hand, if it has consistently out performed the design spec you can have (and I have seen) performance figures of 140%, which can hide poor availability. This is always remembering that one purpose of OEE is to help tell you if you have the capacity to meet customer demand.

Output Quality is a First Time Through measure – what percentage of the output was right first time, without any rework. FTT measures are always the best quality measures. The issue in OEE is that sometimes the quality feedback is not immediate. In FMCG businesses, a customer complaint can be received three months or more after production. In these cases it is best not to include quality in the OEE calculation and use a more customer focused measure for quality – number of complaints etc. If there is no way we can use the Quality component of OEE in a real time improvement cycle, then it is pointless to measure it.

Loss Analysis

The next level of analysis is the seven (or six or eight or sixteen) losses. Within OEE we usually talk about seven losses, although TPM loss structures have been known to define 23 losses in all.

Availability losses are primarily Breakdowns and Changeovers. Changeovers can be separated into Tool changes, Material changes and Reduced Yield at start up, but fundamentally these are the same issue. Further analysis reveals breakdowns to have two fundamental types, those due to deterioration because of inadequate maintenance and those due to inherent machine characteristics.

This gives us three basic responses to availability issues – improve changeovers through SMED, improve basic maintenance and improve machine characteristics. Depending on the Pareto analysis of losses we may need to act on one, two or all three of these.

Performance losses are usually separated into speed loss and minor stops – is the machine running slow, or is it stop-starting? The definition of minor stop is also open to debate – originally it was less than ten minutes, then five minutes, then three minutes. The pragmatic approach is to say that if you can measure the amount of time lost for a stop it is a breakdown, not a minor stop. If you can only record the quantity of stops, then they are minor stops.

There is some practical use for the speed/minor stop distinction – if a machine is running slow we can always speed it up, whereas if it is jamming we need to look at the physical mechanism and try to remove the cause of the jams (my favourite example is where we found the root cause was when metal washers were being loaded into a hopper with a metal shovel, which damaged some, which then jammed the feed – the solution was a plastic shovel!).

We can however also make a useful distinction between performance losses due to deterioration or contamination and those caused by inherent machine characteristics. As with breakdowns this gives us two improvement approaches – better maintenance or equipment re-design.

Improvement

The only reason to measure and analyse anything is to improve it. If we are not going to use the whole improvement cycle there is no point in measuring OEE. It tells us nothing we do not already know. At a gross level all OEE tells you is how much you made compared to what you wanted to make, and any schedule adherence measure would tell you that already. Averaging OEE's over whole plants or time periods just hides issues – OEE is a specific measure for use in specific improvement projects.

The biggest misuse of OEE is to use it to compare different processes, plants or machines. OEE is not a useful executive KPI. It is not even a very useful operational measure. It is an improvement measure, for people who want to improve their equipment performance.

How to massage your OEE

1) When the machine breaks down, log it to planned maintenance

2) Do changeovers during planned maintenance or at weekends if not 24/7
3) Use an easy performance standard
4) Measure the best machine and quote that figure
5) Set arbitrary targets and achieve them through the above

Using the above strategy you should be able to report decent OEE's and even make some money if pay is OEE performance related. What this will not do however is improve your ability to meet customer demand.

How to improve performance

1) Measure against customer demand (OTIF or similar)
2) Measure OEE on constraints or problem equipment
3) Set realistic performance standards
4) Analyse losses to identify issues for improvement
5) Use the whole improvement cycle

Biography
Malcolm Jones founded Productivity Europe in 1989 to develop support and facilitation services in World Class Manufacturing techniques. He learnt from Japanese masters such as Shigeo Shingo and the Total Productivity group at the Japan Management Association, and has edited three books on World Class Manufacturing techniques and practices.

Productivity Europe are leaders in lean manufacturing training and consulting in the UK. Our experienced consultants help you establish a World Class Manufacturing vision through Lean Manufacturing, Total Quality (Six Sigma) and Total Productive Maintenance training.

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